CLAIMS

1 Tissue substance measuring apparatus comprising:

an optical source comprising at least one semiconductor laser, the optical source being coupled to a tissue test site via an optical path which permits transmission of optical energy characterized as middle infrared from said optical source into said tissue; and a pressure transducer system acoustically coupled to said tissue test site.

- Tissue substance measuring apparatus of claim 1, wherein said pressure transducer is arranged to receive acoustic energy generated as a result of absorption of the optical energy at the substance, or a component or marker of the substance, being measured.
- 3 Tissue substance measuring apparatus of claim 2, said at least one semiconductor laser includes a laser of the type known as a quantum cascade laser comprised of quantum well structures.
- Tissue substance measuring apparatus of claim 3, said optical source comprises at least two discrete lasers, said lasers being arranged to address or couple with a common region of tissue.
- 5 Tissue substance measuring apparatus of claim 4, said at least two discrete lasers each operate on a different wavelength.
- Tissue substance measuring apparatus of claim 5, the at least two discrete lasers are coupled via an optical multiplexer to form a beam which addresses the same tissue space, the lasers being operable independently in time.
- 7 Tissue substance measuring apparatus of claim 6, the multiplexer is an optical beam multiplexing device known as a beam combiner.

- 8 Tissue substance measuring apparatus of claim 6, the multiplexer is an optical beam multiplexing device known as a grating or prism type beam combiner.
- 9 Tissue substance measuring apparatus of claim 6, at least two discrete lasers are arranged to address substantially the same space or at least space having similar characteristics.
- Tissue substance measuring apparatus of claim 1, said pressure transducer is coupled to the tissue test site via a coupling whereby the pressure transducer makes intimate and direct contact with a tissue surface.
- Tissue substance measuring apparatus of claim 10, said pressure transducer is coupled to said tissue test site via a coupling comprised of a fluid operable for transmitting an acoustic wave therethrough.
- Tissue substance measuring apparatus of claim 1, said optical source is further comprised of a modulation system electronically connected to said at least one semiconductor laser, the modulation system provides electronic pulses directly through said quantum cascade laser structure to directly modulate output beams.
- Tissue substance measuring apparatus of claim 12, said modulation system is further comprised of a timing system and switch operable for delivering pulses characterized as delta function pulses.
- Tissue substance measuring apparatus of claim 13, said pulses are formed into sets of pulses, or a pulse stream, of finite length, said sets of pulses being characterized as having a duty cycle less than 1/4.
- Tissue substance measuring apparatus of claim 13, said timing system and switch operable for delivering pulse trains which cooperate with a pressure transducer system having a spatial distribution.

- Tissue substance measuring apparatus of claim 1, wherein the optical source generates optical energy in a plurality of wavelength bands each having a center wavelength, the center wavelengths being arranged to correspond to portions of a glucose absorption spectrum where the slope is substantially non-zero.
- Tissue substance measuring apparatus of claim 16, wherein the optical source generates optical energy in at least two wavelength bands each having a center wavelength, the center wavelengths being arranged to correspond to portions of a glucose absorption spectrum on either side of a point where the slope has a transition from increasing slope to decreasing slope, or decreasing slope to increasing slope.
- Apparatus of claim 17, said center wavelengths are arranged to lie symmetrically about the same inflection point.
- Tissue substance measuring apparatus of claim 1, further comprising a data storage means coupled with said pressure transducer system whereby amplitude data may be recorded and stored by the apparatus.
- Tissue substance measuring apparatus of claim 19, the apparatus further comprises a data transmission means arranged to pass stored data to an independent system for post processing and archiving.
- Tissue substance measuring apparatus of claim 1, said optical source comprises at least two semiconductor lasers of the same wavelength.
 - 22 Methods of *in-vivo* substance measurement, comprising the steps:
- a) exciting a quantum cascade semiconductor laser to form an optical pulse set of middle infrared optical radiation;
- b) causing said optical pulse to become incident upon human tissue being measured;

- c) receiving an acoustic return signal which results from interaction between said optical pulse set and substances from which said tissue is comprised; and
- d) determining from the received acoustic signal information about a substance being addressed.
- 23 Methods of claim 22, said 'exciting' step is a direct modulation step whereby current pulses are driven through said semiconductor laser to effect periodic lasing.
- Methods of claim 23, said current pulses are characterized as delta function pulses at a rate of between 10 hz to 10 khz.
- Methods of 23, said current pulses include pulses arranged in a set of finite number.
- 26 Methods of claim 25, the period of pulses is arranged cooperate with a spatial arrangement of a pressure transducer system in view of the speed of acoustic waves in tissues being measured.
- Methods of claim of 22, the 'causing the optical pulse' step is further defined as illuminating interstitial fluid just below an epidermis layer in a living human.
- Methods of claim 27, said 'causing pulse to propagate' step is further defined as providing optical energy of a sufficient quantity such that a substantial portion will penetrate into tissue to a depth between 20 100 microns below the tissue surface.